## The Origins of the Arctic Fox

The arctic fox lives in the far northern Arctic region with other well-known arctic animals like the caribou, musk ox, and polar bear. Scientists aren't sure exactly when the arctic fox first evolved. Arctic fox bone fragments from the Pleistocene epoch (2.6 million-11,700 years ago) are rare, and the ones that do exist are difficult to date with any degree of accuracy. The oldest confirmed arctic fox bone is believed to be 200,000 years old. There are other bones that may be 400,000 years old, but whether they belonged to an arctic fox or some other fox remains under debate. "It's still an open question," says Love Dalen, a Swedish biologist who has been using genetics in an attempt to understand the evolution of the arctic fox. "Right now the best estimate is that arctic foxes emerged somewhere between 200,000 and 400,000 years ago, presumably during one of the ice Ages."

For many years researchers believed the species arose in Europe, basing this conclusion on the location of those 2000-year-old fossils. Since the early 1980s, however, genetic comparisons between different fox species have revealed some surprising results. For example, research done by Robert Wayne at the University of California at Los Angeles has found that the arctic fox, despite its unique appearance and adaptations, is actually much more closely related to other foxes than had previously been thought. Its closest living relative, according to the genetic studies, is the North American swift fox.

The result suggests one of two scenarios. One is that arctic foxes gave rise to swift foxes, an evolutionary sequence that would depend on the arctic fox being much older than the fossil record currently indicates. The second possibility is that swift foxes gave rise to arctic foxes, likely during the height of a period of glaciation when tundra forming to the south of the ice sheets may have met the grassland habitat of the swift fox.

On the one hand, the latter scenario could hardly seem more implausible. Swift foxes, after all, live on the arid, sun-baked prairies and open desert, where temperatures can top 120°F (49°C). It's hard to imagine a greater environmental leap from this environment to the frozen tundra. To have acquired over the course of a few hundred thousand years all the adaptations necessary for survival in such an extreme environment suggests a rapid rate of evolution. And for the early species to have so rapidly conquered such a large territory in a polar region seems equally mystifying.

In other ways, however, this scenario works. As one of the smallest foxes, the swift fox can survive on very little food, a trait that would have helped its ancestors gradually stray farther and farther into the biologically barren tundra. And being a nocturnal hunter that seeks shelter in a den during the day, the swift fox is not overly adapted for life at high temperatures. Indeed, in the northern parts of their range, modern swift foxes have faced winter temperatures every bit as severe as those encountered in the Arctic.

From what researchers know about the evolution of other polar species, there seems to be a pattern of evolution in which species living in the biologically rich temperate zone give rise to animals that are more specialized for survival in the more extreme Arctic. Polar bears, for instance, are thought to have evolved from a northern population of brown bears that learned to hunt seals out on the sea ice. As for the rapid evolution and widespread dispersal, one must remember that the arctic fox is no ordinary species when it comes to both reproductive efficiency and migratory tendency; rapid genetic change and rapid migration would both appear to be well within the species' capabilities.

According to Love Dalen, most of the arctic species evolved during the Quaternary Period (the last 2.6 million years) and they all seem to have evolved from temperate species. In evolutionary terms, arctic species are quite young, including, presumably, the arctic fox. Dalen adds that if that is true, then the arctic fox would have evolved in North America, though he notes that there is no solid proof either way.

【**Paragraph 1**】

The arctic fox lives in the far northern Arctic region with other well-known arctic animals like the caribou, musk ox, and polar bear. Scientists aren't sure exactly when the arctic fox first evolved. Arctic fox bone fragments from the Pleistocene epoch (2.6 million-11,700 years ago) are rare, and the ones that do exist are difficult to date with any degree of accuracy. The oldest confirmed arctic fox bone is believed to be 200,000 years old. There are other bones that may be 400,000 years old, but whether they belonged to an arctic fox or some other fox remains under debate. "It's still an open question," says Love Dalen, a Swedish biologist who has been using genetics in an attempt to understand the evolution of the arctic fox. "Right now the best estimate is that arctic foxes emerged somewhere between 200,000 and 400,000 years ago, presumably during one of the ice Ages."

1. According to paragraph 1, which of the following do scientists now believe about the arctic fox?
2. It emerged at about the same time as the caribou, musk ox, and polar bear.
3. It left a large number of bone fragments during the Pleistocene epoch.
4. It has been in existence for at least 200,000 years.
5. It probably could not survive during any of the Ice Ages.
6. According to paragraph 1, all of the following are reasons why scientists do not know when the arctic fox first appeared EXCEPT:
7. Remains of the arctic fox are difficult to date accurately.
8. The oldest fox bones may be those of other species of fox.
9. Ancient bones from the arctic fox are not found very often.
10. Most signs of the original arctic fox were destroyed during the Ice Ages.

【**Paragraph 2**】

For many years researchers believed the species arose in Europe, basing this conclusion on the location of those 2000-year-old fossils. Since the early 1980s, however, genetic comparisons between different fox species have revealed some surprising results. For example, research done by Robert Wayne at the University of California at Los Angeles has found that the arctic fox, despite its unique appearance and adaptations, is actually much more closely related to other foxes than had previously been thought. Its closest living relative, according to the genetic studies, is the North American swift fox.

1. According to paragraph 2, the belief that the arctic fox arose in Europe is called into question by
2. the location where the oldest confirmed arctic fox bones have been discovered
3. the arctic fox's unique appearance and adaptations
4. the fact that the arctic fox differs greatly in genetic makeup from other fox species
5. the fact that the closest living relative of the arctic fox is a North American fox

【**Paragraph 4**】

On the one hand, the latter scenario could hardly seem more implausible. Swift foxes, after all, live on the arid, sun-baked prairies and open desert, where temperatures can top 120°F (49°C). It's hard to imagine a greater environmental leap from this environment to the frozen tundra. To have acquired over the course of a few hundred thousand years all the adaptations necessary for survival in such an extreme environment suggests a rapid rate of evolution. And for the early species to have so rapidly conquered such a large territory in a polar region seems equally mystifying.

1. Why does the author provide the information that swift foxes " live on the arid, sun-baked prairies and open desert, where temperatures can top 120°F (49°C)." ?
2. To present a reason why arctic foxes might not have evolved from swift foxes
3. To suggest that the evolution of arctic and swift foxes was largely determined by environment
4. To demonstrate that both species need specialized adaptations to survive extreme conditions
5. To highlight how remarkable it is that the same species can live in both environments

【**Paragraph 5**】

In other ways, however, this scenario works. As one of the smallest foxes, the swift fox can survive on very little food, a trait that would have helped its ancestors gradually stray farther and farther into the biologically barren tundra. And being a nocturnal hunter that seeks shelter in a den during the day, the swift fox is not overly adapted for life at high temperatures. Indeed, in the northern parts of their range, modern swift foxes have faced winter temperatures every bit as severe as those encountered in the Arctic.

1. It can be inferred from paragraphs 4 and 5 that if the second scenario is true, then the swift fox must
2. be older than the arctic fox
3. be well adapted to living in extremely high temperatures
4. have transmitted its night-hunting behavior to the arctic fox
5. have grown larger during its evolution into the arctic fox
6. The word "severe" in the passage is closest in meaning to
7. unpredictable
8. unpleasant
9. lasting
10. extreme

【**Paragraph 6**】

From what researchers know about the evolution of other polar species, there seems to be a pattern of evolution in which species living in the biologically rich temperate zone give rise to animals that are more specialized for survival in the more extreme Arctic. Polar bears, for instance, are thought to have evolved from a northern population of brown bears that learned to hunt seals out on the sea ice. As for the rapid evolution and widespread dispersal, one must remember that the arctic fox is no ordinary species when it comes to both reproductive efficiency and migratory tendency; rapid genetic change and rapid migration would both appear to be well within the species' capabilities.

1. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
2. The arctic fox evolved rapidly because of its tendency to migrate and its ability to travel long distances quickly.
3. The arctic fox seems to be quite capable of rapid genetic change and rapid migration.
4. The widespread dispersal of the arctic fox species required rapid genetic change.
5. Reproductive efficiency has been observed to be well within the capabilities of the arctic fox.

【**Paragraph 7**】

According to Love Dalen, most of the arctic species evolved during the Quaternary Period (the last 2.6 million years) and they all seem to have evolved from temperate species. In evolutionary terms, arctic species are quite young, including, presumably, the arctic fox. Dalen adds that if that is true, then the arctic fox would have evolved in North America, though he notes that there is no solid proof either way.

1. Based on the information in paragraph 7, which of the following best describes the work of Love Dalen?
2. He has presented proof that the arctic fox originated in temperate zones.
3. He theorizes that the arctic fox evolved at a later time than most other arctic species.
4. He argues that it is possible that the arctic fox evolved in North America.
5. He believes that the arctic fox is the only arctic species that existed before the start of the Quaternary Period.

■In other ways, however, this scenario works. ■As one of the smallest foxes, the swift fox can survive on very little food, a trait that would have helped its ancestors gradually stray farther and farther into the biologically barren tundra. ■And being a nocturnal hunter that seeks shelter in a den during the day, the swift fox is not overly adapted for life at high temperatures. ■Indeed, in the northern parts of their range, modern swift foxes have faced winter temperatures every bit as severe as those encountered in the Arctic.

1. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**It is consistent with some of the swift fox's adaptations.**

Where would the sentence best fit? Click on a square [■] to add the sentence to the passage.

10. Directions: An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some answer choices do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**The arctic fox is currently thought to have emerged within the last 400,000 years, during one of the Ice Ages.**

1. Scientific dating of fossil evidence shows that the arctic fox appeared no more than 400,000 years ago. which means it is too recent as a species to be the ancestor of the swift fox.
2. Unless the arctic fox is much older than currently believed. it probably evolved from the swift fox, and in spite of great differences in their habitats, characteristics of these two foxes ft with this view.
3. Like the polar bear, the arctic fox seems to have evolved from northern populations of a temperate species that learned to hunt animals that had already adapted to living conditions on the sea ice.
4. Although the arctic fox was earlier thought to have evolved in Europe, genetic studies have shown that its closest living relative is the North American swift fox.
5. It seems unlikely the swift fox could have evolved and expanded quickly into an extremely hot climate, but other temperate species did it. and the swift fox has a strong ability to adapt.
6. That the arctic fox evolved from the swift fox fits with the view that some arctic species seem to have evolved from species living in the temperate zone that are adapted for survival in cold environments.